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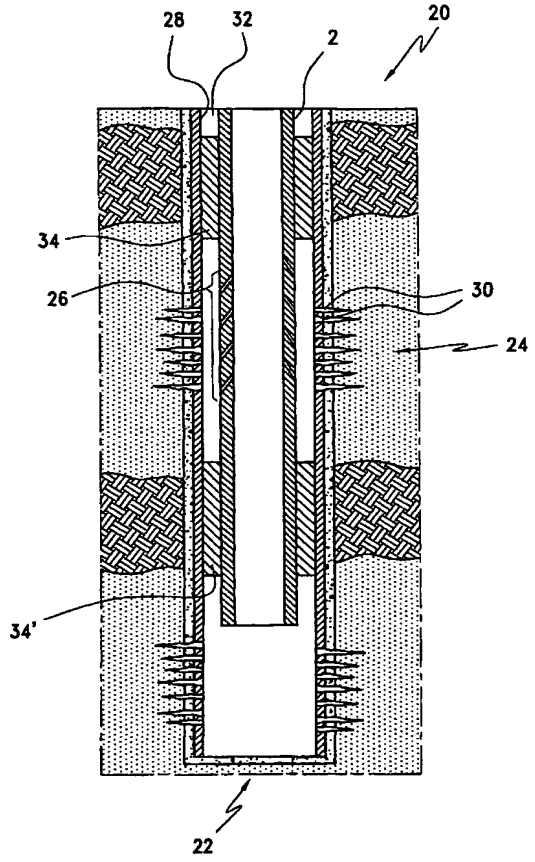
[Continued on next page]

(54) Title: WELL COMPLETION WITH MERGED INFLUX OF WELL FLUIDS



(57) Abstract: The objective of the invention is to smoothly merge the influx flow streams with the wellbore flow stream so as to reduce the pressure drop along the perforated section of the wellbore liner. There is disclosed a completion liner (2) for a well for the production of hydrocarbons is provided with angled ports (26) through the sidewall which reduce pressure drop along the length of the liner. There is also disclosed short imperforated completion tubing (106) for a well for the production of hydrocarbons is concentrically mounted alongside substantially only the perforated section of the production tubing (110) to cause production fluids to initially flow toward the wellhead along an annulus defined between completion tubing and the production tubing prior to exiting the annulus and commingling with fluids produced from further down hole. There is further disclosed a completion casing for a well for the production of hydrocarbons which is provided with angled perforations through the casing sidewall (326) which reduce flow resistance along length of the casing.

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AMENDED CLAIMS

[received by the International Bureau on 11 August 2004 (11.08.04);
original claims 11-26 replaced by amended claims 11-25 (5 pages)]

11. A well as in claim 10 further comprising
a casing (28) which lines the borehole from the surface of the earth to the hydrocarbon production zone, said casing being positioned between the well production tubular and the earth and being perforated by perforations (30) in the hydrocarbon production zone to permit hydrocarbon to flow from the earth, though the casing, into the well production tubular and to the surface of the earth.

12. A well as in claim 11 wherein an annulus (32) is formed between the casing and the well production tubular.

13. A well as in claim 12 further comprising a packer (34) sealingly positioned in the annulus spaced apart from the hydrocarbon production zone to channel hydrocarbon flow from the hydrocarbon production zone, through the influx ports, and into the production tubular.

14. A concentric tubing and mounting system (102) for use in completing a well (104), said system comprising
a tubular member (106) having an inlet end, an outlet end, and a longitudinal axis extending between the ends,
a first mounting device (108) positioned on an outside surface of the tubular member near the inlet end of the tubular member for mounting the inlet end of the tubular member on an inside surface of a well production tubing (110);
a second mounting device (112) positioned on an outside surface of the tubular member near the outlet end of the tubular member for mounting the outlet end of the tubular member to the inside surface of a well production tubing,
wherein the second mounting device defines a plurality of flow paths to permit fluid flow through the mounting device in a direction parallel to the longitudinal axis of the tubular member.

15. A concentric tubing and mounting system as in claim 14 wherein the first mounting device is annularly shaped and is selectively expandable for setting securely against an inside of a well production tubing.

16. A concentric tubing and mounting system as in claim 14 further comprising a converging inlet element (114) positioned on the inlet end of the tubular member to provide a smoothly narrowing fluid flow path from an inside surface of a well production tubing to the inside of the tubular member.

17. A well (124) for the production of hydrocarbons, comprising

a borehole extending into the earth from a wellhead at the surface of the earth and into a hydrocarbon production zone (125),

a production tubing (130) positioned in the borehole and extending into the hydrocarbon production zone from the wellhead,

said production tubing having a first perforated section (140) positioned in the hydrocarbon production zone and a second perforated section (142) positioned between the first perforated section and the wellhead,

a completion tubing (126) having an inlet end, an outlet end, and a longitudinal axis extending between the ends,

a first mounting device (128) positioned on an outside surface of the completion tubing near the inlet end of the completion tubing mounting the inlet end of the completion tubing to an inside surface of the production tubing between the first perforated section and the second perforated section, and

a second mounting device (132) positioned on the outside surface of the completion tubing near the outlet end of the completion tubing mounting the outlet end of the completion tubing to the inside surface of the well production tubing between the second perforated section and the wellhead,
said outlet end of the completion tubing being positioned a short distance above the second perforated section,
whereby fluid flowing into the production tubing through the perforations of the second perforated section flows into an annulus defined between the completion tubing and the production tubing.

18. A well as in claim 17 wherein the second perforated section is positioned in the first production zone.

19. A well as in claim 17 wherein the second perforated section is positioned in a second production zone (125').

20. A well as in claim 17 wherein

the hydrocarbon production zone constitutes a first hydrocarbon production zone (125), and the borehole further extends through a second hydrocarbon production zone (125') positioned between the first hydrocarbon production zone and the wellhead,

the production tubing further has a third perforated section (142') positioned between the second perforated section and the wellhead alongside the second hydrocarbon production zone,

and the completion tubing constitutes a first completion tubing,

said well further comprising

a second completion tubing (126') positioned between the first completion tubing and the wellhead, said second completion tubing having an inlet end, an outlet end, and a longitudinal axis extending between the ends;
a first mounting device (128') positioned on an outside surface of the second completion tubing near the inlet end of the second completion tubing mounting the inlet end of the second completion tubing on an inside surface of the production tubing between the second perforated section and the third perforated section, and
a second mounting device (132') positioned on the outside surface of the second completion tubing near the outlet end of the second completion tubing mounting the outlet end of the second completion tubing to the inside surface of the well production tubing between the third perforated section and the wellhead,
said outlet end of the second completion tubing being positioned a short distance above the third perforated section,
whereby fluid flowing into the production tubing through the perforations of the third perforated section flows into an annulus defined between the completion tubing and the production tubing.

21. A well (202) for the production of hydrocarbons, comprising

a well bore (204) extending into the earth from the surface of the earth into a hydrocarbon production zone (206), and

a well bore casing (208) positioned in the borehole, said well bore casing having a longitudinal axis, a generally annular cross section across the longitudinal axis, a wellhead end, a well bottom end, and a plurality of perforations (210) opening through a sidewall of the casing along a segment of the casing positioned in the hydrocarbon production zone which form plurality of flow paths from an outer

surface of the casing to an inner surface of the casing, said perforations being formed through the sidewall at an obtuse angle D with respect to the longitudinal axis of the casing in the direction of the wellhead end so that substantially all hydrocarbon flowing from the hydrocarbon production zone and into the casing exits the perforations with a substantial axial velocity component toward the wellhead end of the casing.

22. A well as in claim 21 further comprising
a cement layer (212) which lines the wellbore at least across the hydrocarbon production zone, said cement layer being positioned between the well bore casing and the earth and being perforated by the perforations to permit hydrocarbon to flow from the earth, though the cement layer, into the well bore casing and to the surface of the earth.

23. A well as in claim 22 wherein the cement is positioned in an annulus between the casing and the well bore.

24. A well as in claim 21 which is highly deviated from vertical in the production zone.

25. A well as in claim 21 wherein the well bore casing is substantially imperforate apart from the segment of the casing positioned in the hydrocarbon production zone.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US03/11928

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : E21B 43/08
US CL : 166/242.1, 242.5

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
U.S. : 166/242.1, 242.5, 242.7, 169, 227, 233, 236

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
WEST

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,415,227 A (Jennings, Jr.) 16 May 1995, Fig. 2, col. 2, line 56-col 3, line 15.	14, 15
X	US 5,484,018 A (Cavender et al.) 16 January 1996, Fig.1, and col. 2, line 23-col. 3, line 45.	14, 15, 18, 19, 20, 21
X	US 6,186,236 B1 (Cox) 13 February 2001, Figs 1-4, col. 3, line 39-col. 5, line 46.	14, 15, 18-21
A	US 6,097,494 A (Longbottom et al.) 27 June 2000, entire document.	1-26
A	US 5,505,262 (Cobb) 9 April 1996, entire document.	1-26
A	US 4,756,371 A (Brieger) 12 July 12 1988, entire document.	1-26
A	US 5,318,119 A (Lowry et al.) 7 June 1994, entire document.	1-26

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
18 July 2003 (18.07.2003)	22 JUN 2004
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